Ft Monmouth Sanitary Landfills permit / Studies on 5

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
CN 029
TRENTON, N.J. 08625

OCT 4 1983

Mr. Vincent P. Dewar
Acting Facilities Engineer
US Army Communications - Electronics Command
Bldg. 167 SELHI-FE
Fort Monmouth, New Jersey 07003

RE: RCRA Declassification Request
EPA ID # NJD000537274

Dear Mr. Dewar:

This letter is in response to your request of March 1, 1983 for declassification as a TSD facility under the Resource Conservation and Recovery Act.

Since the elementary neutralization unit for which the Part A was originally filed is no longer in operation, your request is approved. Your facility is no longer included in the New Jersey Department of Environmental Protection's list of existing hazardous waste treatment facilities, and is hereby declassified as a TSD facility.

The discharge from the facility into the sewer is under the authority of the New Jersey Water Pollution Control Act, N.J.S.A. 58:10A-1.1 et seq. You are required to conform to the Rules and Regulations of the Northeast Monmouth Regional Sewerage Authority. However, you are not subject to the Industrial Waste Management Facility requirements of the NJDEP, as referred to in the July 22, 1983 letter to you from Mr. Frank Coolick of the NJDEP.

If there are any questions concerning this letter, please call me at (609) 292-4860.

Very truly yours,

ORIGINAL signed and mailed

Kenneth Goldstein, P.E., Chief
Industrial Pretreatment Section
Water Quality Management

WQM8:tmc

cc: F. Coolick, Div. of Waste Management
D. Leu, Div. of Waste Management
J. Golumbek, USEPA

389422

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HSHS-EW-M

SUBJECT: Water Quality Engineering Consultation No. 32-24-0725-86, Stream and Ground-Water Monitoring Well Sampling for Landfill Discharge Determination, Fort Monmouth, New Jersey, 1 October 1985

Commander
US Army Materiel Command
ATTN: AMCSG
5001 Eisenhower Avenue
Alexandria, VA 22333-0001

1. AUTHORITY.

a. Letter, MEDDAC, Ft. Monmouth, HSCL-P, 06 September 1985, Subject: Request for Laboratory Support

b. FONECON between Mr. Bob King, AMC Environmental Office, and Mr. Steve Kistner, this Agency, 27 September 1985, SAB.

2. REFERENCES.

a. Letter, this Agency, HSHB-EW-M/WP, 14 December 1984, subject: Water Quality Engineering Study No. 32-24-0475-84, Stream Sampling For Landfill Discharge Determination, Fort Monmouth, New Jersey, 29 May-7 June 1984.

b. Letter, this Agency, HSHB-EW-M, 15 March 1985, subject: Addendum, Water Quality Engineering Study No. 32-24-0475-85, Stream Sampling For Landfill Discharge Determination, Fort Monmouth, New Jersey, 29 May- 7 June 1984.

3. PURPOSE. This consultation was performed to determine if leachate from Fort Monmouth landfills is entering adjacent waterways; and to provide supplemental data for the New Jersey Pollutant Discharge Elimination System (NJPDES) Permit.

4. GENERAL.

a. Five sanitary landfills, located in low-lying areas adjacent to streams at Fort Monmouth have been closed since 1980, terminating trash dumping. The materials contained in these landfills are assumed to be either in close proximity to or in direct contact with the ground water.

Should any landfill leachate be released, the contaminated ground water would most likely be discharged into the adjacent stream channels. Regulations of New Jersey Department of Environmental Protection (NJDEP) prohibit any point source from discharging of leachate without a permit, either to ground water or to surface water.

b. Personnel of this Agency collected surface water samples both upstream and downstream of each of five Fort Monmouth landfills and five ground water monitoring wells on 1 October 1985. The samples were properly iced, preserved and shipped to a private laboratory contracted by this Agency for the purpose of analysis.

c. The five above mentioned landfills and sample point locations as well as five ground-water monitoring wells are shown in the Figure.

5. FINDINGS.

a. Analytical results 'for samples collected upstream and downstream of landfills A, B, C, D, and E are contained in Table 1 through Table 6 (similar format as reference a).

b. Increases/decreases in concentrations of several parameters across the landfills were noted.

c. Significant increases in concentrations of chloride, total dissolved solids, and sodium were observed across most of the landfills.

d. The five ground-water monitoring well analytical data are shown in Table 7.

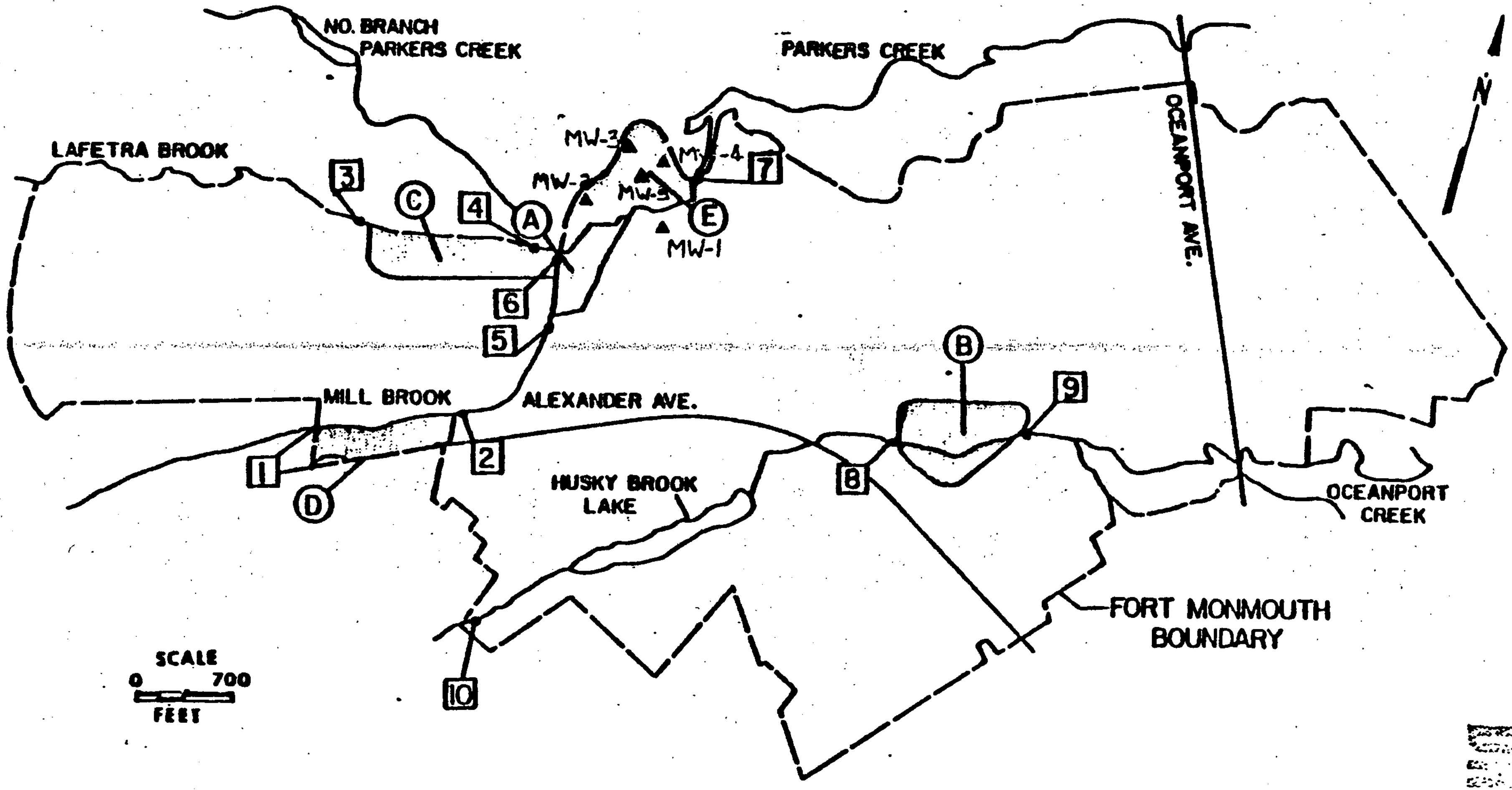
6. CONCLUSIONS.

a. Review of analytical results indicated that tidal effects are attributable to the significant increases in concentrations of chloride, total dissolved solids and sodium across most of the five landfills rather than landfill leachate sources.

b. In total, the landfills are having minimal impact on the streams flowing through Fort Monmouth.

7. RECOMMENDATION. Based on good environmental engineering practices; present the analytical results and conclusions to the NJDEP for applicable permit.

8. TECHNICAL ASSISTANCE. Requests for services should be directed through
appropriate command channels of the requesting activity to



LEGEND

1 SAMPLE POINT NUMBER

A LANDFILL

FIGURE

FORT MONMOUTH LANDFILLS

AND SAMPLE POINT LOCATIONS

Commander, U S Army Environmental Hygiene Agency, ATTN: HSHB-EW, Aberdeen Proving Ground, MD. 21020-5422, with an information copy furnished to the Commander, US Army Health Service Command, ATTN: HSCL-P, Fort Sam Houston, TX 782346000.

FOR THE COMMANDER:

7 Encls

KARL J. DAUBEL
Colonel, MS
Director, Environmental Quality

CF:
HQDA (DASG-PSP)
Cdr, CECOM
Cdr, HSC (HSCL-P)
Cdr, Fort Monmouth (2 cys)
Cdr, WRAMC (PVNTMED Svc)
Cdr, MEDDAC, Ft. Monmouth (PVNTMED Svc) (2 cys)
Cdr, USAEHA Fld Spr Acty, Ft. Meade

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TABLE 1. ANALYTICAL RESULTS - FORT MONMOUTH LANDFILL DISCHARGE - LANDFILL A

PARAMETER (ALL UNITS MG/L)	UPSTREAM CONCN SAMPLE POINT 5	DOWNSTREAM CONCN SAMPLE POINT 6	INCREASE/DECREASE CONCENTRATION
BIOCHEMICAL OXYGEN DEMAND	1.1	1.1	---
TOTAL ORGANIC CARBON	2.3	2.0	0.3 DECREASE
CHEMICAL OXYGEN DEMAND	<25	<25	---
AMMONIA-NITROGEN	1.0	1.1	0.1 INCREASE
NITRATE/NITRITE NITROGEN	0.54	0.61	0.07 INCREASE
PHENOLS	<0.01	<0.01	---
CHLORIDE	1065	1282	217 INCREASE
SULFATE	149	244	95 INCREASE
COLOR	20	30	10 INCREASE
FOAMING AGENTS (MBAS)	<0.05	<0.05	---
PH (STANDARD UNITS)	4.3	4.5	0.2 INCREASE
TOTAL DISSOLVED SOLIDS	2680	2758	78 INCREASE
COPPER	0.094	0.081	0.013 DECREASE
IRON	5.86	5.05	0.81 DECREASE
LEAD	0.004	<0.001	>0.003 DECREASE
SODIUM	444.5	851.0	406.5 INCREASE
ZINC	0.185	0.159	0.026 DECREASE

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TABLE 2. ANALYTICAL RESULTS - FORT MONMOUTH LANDFILL DISCHARGE - LANDFILL B

PARAMETER (ALL UNITS MG/L)	UPSTREAM CONCN SAMPLE POINT 8	DOWNSTREAM CONCN SAMPLE POINT 9	INCREASE/DECREASE CONCENTRATION
BIOCHEMICAL OXYGEN DEMAND	<1.0	1.7	>0.7 INCREASE
TOTAL ORGANIC CARBON	<2.0	2.9	>0.9 INCREASE
CHEMICAL OXYGEN DEMAND	<25	307	>282 INCREASE
AMMONIA-NITROGEN	0.43	1.2	0.77 INCREASE
NITRATE/NITRITE NITROGEN	0.50	0.42	0.08 DECREASE
PHENOLS	<0.01	<0.01	---
CHLORIDE	20	5815	5795 INCREASE
SULFATE	9.4	394	384.6 INCREASE
COLOR	55	45	10 DECREASE
FOAMING AGENTS (MBAS)	<0.05	<0.05	---
PH (STANDARD UNITS)	7.3	7.0	0.3 DECREASE
TOTAL DISSOLVED SOLIDS	93	12592	12499 INCREASE
COPPER	<0.025	0.032	>0.007 INCREASE
IRON	2.65	2.37	0.28 DECREASE
LEAD	0.005	0.035	0.03 INCREASE
SODIUM	11.80	3654.0	3642.2 INCREASE
ZINC	0.030	0.023	0.007 DECREASE

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TABLE 3. ANALYTICAL RESULTS - FORT MONMOUTH LANDFILL DISCHARGE - LANDFILL C

PARAMETER (ALL UNITS MG/L)	UPSTREAM CONCN SAMPLE POINT 3	DOWNSTREAM CONCN SAMPLE POINT 4	INCREASE/DECREASE CONCENTRATION
BIOCHEMICAL OXYGEN DEMAND	<1.0	<1.0	---
TOTAL ORGANIC CARBON	3.6	3.2	0.4 DECREASE
CHEMICAL OXYGEN DEMAND	<25	75	INCREASE
AMMONIA-NITROGEN	0.65	1.0	0.35 INCREASE
NITRATE/NITRITE NITROGEN	0.52	0.38	0.14 DECREASE
PHENOLS	<0.01	<0.01	---
CHLORIDE	315	2924	2609 INCREASE
SULFATE	52	308	256 INCREASE
COLOR	100	40	60 DECREASE
FOAMING AGENTS (MBAS)	<0.05	<0.05	---
PH (STANDARD UNITS)	6.9	6.9	---
TOTAL DISSOLVED SOLIDS	779	5917	5138 INCREASE
COPPER	0.027	<0.025	>0.002 DECREASE
IRON	4.67	3.91	0.76 DECREASE
LEAD	<0.001	<0.001	---
SODIUM	168.4	1502.1	1333.7 INCREASE
ZINC	0.130	0.090	0.04 DECREASE

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TABLE 4. ANALYTICAL RESULTS - FORT MONMOUTH LANDFILL DISCHARGE - LANDFILL D

PARAMETER (ALL UNITS MG/L)	UPSTREAM CONCN SAMPLE POINT 1	DOWNSTREAM CONCN SAMPLE POINT 2	INCREASE/DECREASE CONCENTRATION
BIOCHEMICAL OXYGEN DEMAND	<1.0	<1.0	---
TOTAL ORGANIC CARBON	16	17	1 INCREASE
CHEMICAL OXYGEN DEMAND	<25	<25	---
AMMONIA-NITROGEN	0.65	0.65	---
NITRATE/NITRITE NITROGEN	0.62	0.71	0.009 INCREASE
PHENOLS	<0.01	0.01	INCREASE
CHLORIDE	38	41	3 INCREASE
SULFATE	70	1.6	68.4 DECREASE
COLOR	15	20	5 INCREASE
FOAMING AGENTS (MBAS)	0.06	<0.05	>0.01 DECREASE
PH (STANDARD UNITS)	3.0	2.9	0.1 DECREASE
TOTAL DISSOLVED SOLIDS	211	210	1 DECREASE
COPPER	0.093	0.097	0.004 INCREASE
IRON	6.11	6.54	0.43 INCREASE
LEAD	0.017	0.012	0.005 DECREASE
SODIUM	19.36	19.83	0.47 INCREASE
ZINC	0.211	0.227	0.016 INCREASE

TABLE 5. ANALYTICAL RESULTS - FORT MONMOUTH LANDFILL DISCHARGE - LANDFILL E

PARAMETER (ALL UNITS MG/L)	UPSTREAM CONCN SAMPLE POINT 4	UPSTREAM CONCN SAMPLE POINT 6	DOWNSTREAM CONCN SAMPLE POINT 7
BIOCHEMICAL OXYGEN DEMAND	<1.0	1.1	<1.0
TOTAL ORGANIC CARBON	3.2	2.0	<2.0
CHEMICAL OXYGEN DEMAND	75	<25	562
AMMONIA-NITROGEN	1.0	1.1	1.1
NITRATE/NITRITE NITROGEN	0.38	0.61	0.17
PHENOLS	<0.01	<0.01	<0.01
CHLORIDE	2924	1282	3288
SULFATE	308	244	12
COLOR	40	30	35
FOAMING AGENTS (MBAS)	<0.05	<0.05	<0.05
PH (STANDARD UNITS)	6.9	4.5	7.1
TOTAL DISSOLVED SOLIDS	5917	2758	19718
COPPER	<0.025	0.081	0.035
IRON	3.91	5.05	1.08
LEAD	<0.001	<0.001	0.078
SODIUM	1502.1	851.0	5514
ZINC	0.090	0.159	0.021

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TABLE 6. ANALYTICAL RESULTS - FORT MONMOUTH LANDFILL DISCHARGE

PARAMETER (ALL UNITS MG/L)	UPSTREAM CONCN SAMPLE POINT 10	DOWNSTREAM CONCN SAMPLE POINT 8	INCREASE/DECREASE CONCENTRATION
BIOCHEMICAL OXYGEN DEMAND	<1.0	<1.0	
TOTAL ORGANIC CARBON	12	<2.0	
CHEMICAL OXYGEN DEMAND	<25	<25	
AMMONIA-NITROGEN	<0.20	0.43	
NITRATE/NITRITE NITROGEN	1.0	0.50	
PHENOLS	<0.01	<0.01	
CHLORIDE	30	20	
SULFATE	25	9.4	
COLOR	15	55	
FOAMING AGENTS (MBAS)	<0.05	<0.05	
PH (STANDARD UNITS)	7.2	7.3	
TOTAL DISSOLVED SOLIDS	198	93	
COPPER	<0.025	<0.025	
IRON	0.611	2.65	
LEAD	<0.001	0.005	
SODIUM	18.00	11.80	
ZINC	0.079	0.030	

TABLE 7. ANALYTICAL RESULTS - FORT MONMOUTH MONITORING WELLS

PARAMETER (ALL UNITS MG/L)	NO.1	NO.2	NO.3	NO.4	NO.5
BIOCHEMICAL OXYGEN DEMAND	1.1	1.1	1.2	<1.0	*
TOTAL ORGANIC CARBON	4.3	11	33	61	18
CHEMICAL OXYGEN DEMAND	428	222	92	261	<25
AMMONIA-NITROGEN	<0.20	3.2	20	133	3.8
NITRATE/NITRITE NITROGEN	2.5	0.02	0.03	0.02	2.5
PHENOLS	<0.01	<0.01	<0.01	0.02	0.06
CHLORIDE	3.9	3239	538	1500	75
SULFATE	26	99	79	69	21
COLOR	250	750	500	1000	<5.0
FOAMING AGENTS (MBAS)	<0.05	0.08	0.16	0.09	0.46
PH (STANDARD UNITS)	5.2	6.8	7.0	6.7	5.0
TOTAL DISSOLVED SOLIDS	216	7179	2130	3276	346
COPPER	0.030	0.039	0.066	0.124	0.474
IRON	<0.100	23.6	0.203	2.63	0.584
LEAD	<0.001	<0.001	<0.001	<0.001	<0.001
SODIUM	10.25	1828.8	265.1	767.0	4.5
ZINC	0.254	0.299	0.121	0.177	0.440

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

ISHB-EW-M/WP

WATER QUALITY ENGINEERING STUDY NO. 32-24-0475-85
STREAM SAMPLING FOR LANDFILL DISCHARGE DETERMINATION
FORT MONMOUTH, NEW JERSEY
29 MAY - 7 JUNE 1984

. AUTHORITY. Letter, Fort Monmouth, SELHI-EH-EV, undated, subject: Water uality Survey for Streams Affected by Sanitary Landfill Leachate on Fort onmouth, with initial endorsement, HQ, DARCOM, DRCSG-E, 20 January 1984.

. REFERENCES. References are contained in Appendix A.

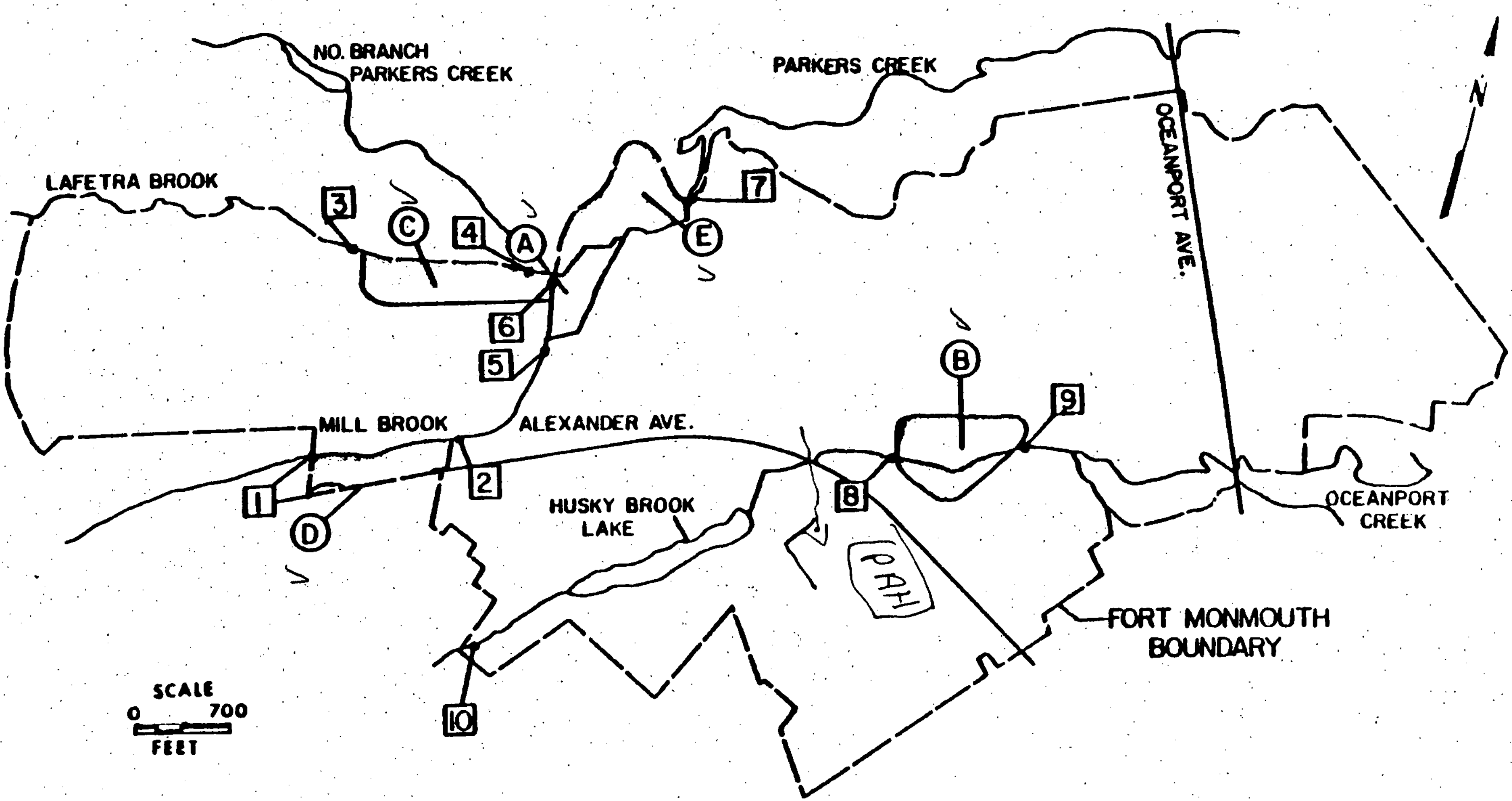
. PURPOSE. To determine if leachate from Fort Monmouth landfills is ntering adjacent waterways.

. GENERAL.

a. Personnel Contacted. See Appendix B for a listing of personnel ontacted.

b. Background.

(1) Five distinct locations at Fort Monmouth have been utilized as Solid waste landfills since 1940. All landfills are now closed, with the umping of trash at the last site terminated in 1980. Since that time, the nstallation has been transporting all solid waste offpost for disposal. ach landfill, labeled A through E in the following Figure, is located in a ow-lying area adjacent to one of the streams which flows through the nstallation. These locations were presumably very wet and marshy prior to umping, with four landfills being sited in tidal areas. It has, therefore, een assumed that the landfilled materials are either in very close proximity o or in direct contact with the ground water, especially at higher tidal onditions. Furthermore, if leachate is emanating from any of the landfills, t is suspected that natural ground-water flow toward the adjacent stream Channels (particularly during falling tides) will result in the discharge of Contaminated ground water into these channels. Personnel of this Agency, therefore, believe that analysis of stream samples collected at carefully Selected locations and under proper tidal conditions will indicate whether leachate sources exist at any of the landfills. A detailed description of geohydrologic considerations is provided in Appendix C.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PARKERS CREEK
LAFETRA BROOK
OCEANPORT AVE.
N
MILL BROOK
ALEXANDER AVE.
HUSKY BROOK
LAKE
OCEANPORT
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6. CONCLUSIONS.

a. The concentrations of chloride, sulfate, hardness, conductivity, and sodium increased across most of the landfills. However, these changes were most likely due to the increased salinity of the streams as sample collection sites approached the downstream estuaries, and not attributable landfill leachate sources.

b. A significant increase in the concentration of mercury across Landf A was probably attributable to leachate from this landfill barring laborato and/or sampling error. Minor changes in the concentrations of several othe parameters, although potentially traceable to the effects of the landfill, were of negligible importance.

c. No changes in stream quality across Landfill B were attributable to landfill leachate.

d. A significant increase in color was detected across Landfill C. However, because all other changes were very minor, no appreciable source o leachate is believed to be emanating from this landfill.

e. Minor changes in the concentrations of several parameters across Landfill D, although potentially traceable to the effects of landfill leachate, were of negligible importance.

f. Any potential increases in the concentrations of parameters across landfill E were minor and of negligible importance.

g. In total, the landfills are having minimal impact on the streams flowing through Fort Monmouth.

h. Husky Brook, at the point where it flows onto Fort Monmouth, had concentrations of cadmium, zinc, and tetrachloroethylene which were higher than those at any other sampling location. All other parameters were detec at concentrations similar to those observed at the other SP's.

7. RECOMMENDATIONS.

a. Present the analytical results and conclusions of this study to th NJDEP in compliance with the NJPDES regulations.

b. Perform resampling at Landfill A to determine if the mercury resul at this location were correct (This recommendation is based on good engine ing practice.)

8. TECHNICAL ASSISTANCE. Requests for services should be directed throug appropriate command channels of the requesting activity to the Commander, Army Environmental Hygiene Agency, ATTN: HSHB-EW-M, Aberdeen Proving Grou MD 21010-5422, with an information copy furnished the Commander, US Army Health Services Command, ATTN: HSCL-P, Fort Sam Houston, TX 78234-6000.

Michael E. Resch
MICHAEL E. RESCH
Environmental Engineer
Water Quality Engineering Division

Wayne A Fox
WAYNE A. FOX
Geologist
Waste Disposal Engineering Divisio

APPROVED:

for Stephen L. Kistner
JAMES M. STRATTA
LTC, MS
Chief, Water Quality Engineering Division

(2) The State of New Jersey Department of Environmental Protection (NJDEP) established the New Jersey Pollutant Discharge Elimination System (NJPDES) regulations in March 1981 (reference 1, Appendix A). These regulations not only prohibit the unpermitted point source discharge of pollutants to surface water, but also unpermitted discharges of pollutants to the ground water. The discharge of leachate to the ground water from both closed landfills and those currently in operation are specifically covered by these regulations. The NJDEP has requested Fort Monmouth to investigate the potential for ground-water or surface-water contamination by the above-mentioned landfills.

c. Survey Execution.

(1) Ten sampling points (SP's) were selected. As shown in the Figure, one SP was upstream from each landfill and one SP was downstream of each landfill. Since landfills A, C, and E are adjacent to one another, and since the same streams border all three, the downgradient SP's for A and C serve as the upgradient SP for E. Sample point 10 was chosen to depict Husky Brook water quality at the location where that stream enters the installation.

(2) As previously stated, most of the streams are affected by tides. In order to meet the tidal sampling requirements outlined above, sampling was accomplished during the period between high and low tides while the stream levels were declining. This was accomplished with the assumption that this condition would approximate worst-case conditions.

(3) Sampling occurred over a 3-day period. On each day, samples taken at each SP for biochemical oxygen demand, surfactants, total coliforms, turbidity, and color were obtained. These samples were packaged and shipped to the Directorate of Laboratory Services, this Agency for analyses. One grab sample was collected at each SP for hexavalent chromium, odor, pesticides, and all organic priority pollutants. Additionally, 3 days of sampling were composited into one sample at each SP for analyses of numerous other metal and nonmetal parameters. Summaries of analytical results are provided in Appendix D. Analytical methodologies are contained in Appendix E.

(4) Each day at each sample point, several physical stream characteristics were obtained - channel depth, channel width, and stream velocity. In addition, pH and conductivity were measured daily at each location.

(5) This study was performed by Michael E. Resch, P.E.; Mark D. Nickelson; and Stephen L. Kistner, P.E.; Water Quality Engineering Division; and Wayne A. Fox, Waste Disposal Engineering Division, this Agency.

(6) The preliminary findings of this study are contained in reference 2, Appendix A.

increases, downstream concentrations for each of these parameters were still within acceptable levels. A substantial increase in color of 40 units was observed. Additionally, iron increased 1.2 mg/L (18 lbs/day based on a measured flow of 2.8 cfs), and manganese increased 0.02 mg/L (0.3 lbs/day) across the landfill. Gross beta increased on average 0.6 pCi/L (4.1 µCi/day) to 3.5 pCi/L. Statistically, there was an 18-percent probability that there was no actual increase in this parameter. As before, the recorded concentrations were well below the NIPDWR MCL for gross beta activity. No organic priority pollutants were detected at either sampling location.

d. Landfill D. Table D-4 contains the analytical results for samples collected both upstream (SP 1) and downstream (SP 2) of Landfill D on Mill Brook. Two of the brackish water parameters, sodium and TDS, experienced minor increases across the landfill. Minor increases were also detected in the concentrations of total suspended solids, ammonia and nitrate/nitrite nitrogens, turbidity, and odor. The only metal to increase downstream was iron at 0.23 mg/L (15 lbs/day based on a measure flow of 11.7 cfs). Gross beta increased an average of 0.1 pCi/L (2.9 µCi/day) to 3.1 pCi/L, well below the NIPDWR MCL. Statistically, there was a 43-percent probability that there was no actual increase in this parameter. No organic priority pollutants were detected at either SP.

e. Landfill E. Analytical results for the Landfill E SP's are contained in Table D-5. As shown in the Figure, three separate streams join to form Parker's Creek which flows along the side of Landfill E. The sampling locations upstream of this landfill were SP 4 at the mouth of Lafetra Brook and SP 6 at the mouth of Mill Brook. The North Branch of Parker's Creek drains the area north of the Fort Monmouth reservation and flows into Parker's Creek below the confluence of Lafetra and Mill Brooks. Sampling could not be accomplished at the North Branch because of its inaccessibility from the installation property. The flows measured at SP's 4 and 6 were 2.8 cfs and 11.8 cfs, respectively. The flow measured at the downstream SP 7 was 38.5 cfs. Therefore, the flow from the North Branch Parker's Creek was 23.9 cfs. The analytical results for SP's 4 and 6, upstream of Landfill E, and SP 7, downstream of the landfill, are contained in Table D-5. Because of the unknown chemical quality of the North Branch, increases in concentrations of each parameter across the landfill cannot be determined with assurance. However, the assumption was made that the North Branch will be similar in quality to the other streams at the SP's upstream of the landfills. Implied in this assumption is the further assumption that no unnatural sources of any of the chemical parameters were present on the North Branch. These assumptions will yield the worst-case results by providing the maximum reasonable quantity of each parameter which the landfilled materials could have been added to the stream. Given the above reasoning, only four parameters actually increased across Landfill E. The sodium and conductivity increases are due to the increased salinity of SP 7. Additionally, minor increases in the levels of nitrate/nitrite nitrogen and zinc were detected. No organic priority pollutants were detected at any of the SP's.

f. Sample Point 10. Sample Point 10 was chosen to depict the Husky Brook water quality at the location where that stream enters the installation. The analytical results from samples collected at this SP are compared to those reported from SP 8 downstream. Concentrations of cadmium, zinc and tetrachloroethylene at SP 10 were somewhat higher than those at SP 8 as well as the other SP's utilized in this study. All other parameters were detected at concentrations similar to those observed at the other sampling locations.

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5. FINDINGS AND DISCUSSION.

a. Landfill A. Table D-1 contains the analytical results for samples collected both upstream (SP 5) and downstream (SP 6) of Landfill A on Mill Brook. Minor changes in concentrations of several parameters across the landfill were observed. The minor increases in the levels of sulfate, hardness, conductivity, and sodium were due to the increased salinity of the stream as sample collection sites approached the downstream estuary. Additional minor changes were a decrease in pH of 0.1 unit and an increase in odor from less than 1.0 to 1.2 threshold odor numbers. Concentrations of three different metals increased across Landfill A. These increased concentrations were mathematically converted to increased loadings in pounds per day (lbs/day) utilizing the measured flow rate of 11.8 cubic feet per second (cfs). These increases were 0.02 milligrams/liter (mg/L) (1.3 lbs/day) iron, 0.5 micrograms/liter (µg/L) (0.03 lbs/day) of lead, and 8 µg/L (0.52 lbs/day) of mercury. This increase in mercury was the only significant change detected for any metal across this landfill. If a source of leachate was present, significant increases in the concentrations of several metals could be anticipated. Since this was not the case in this situation, resampling at this location will indicate if the reported mercury results were erroneous. The gross beta radionuclides increased by a mean of 0.8 picocuries/liter (pCi/L) or a loading of 23 microcuries/day (µCi/day). Given the statistical distribution of the reported mean differences, there is an 11-percent probability that there was no actual increase in gross beta concentration. The downstream concentration of 3.8 pCi/L was well below the National Interim Primary Drinking Water regulations (NIPDWR) maximum contaminant level (MCL) of 50 pCi/L (see reference 3, Appendix A). As such this increase was considered to be insignificant. No organic priority pollutants were detected. The list of all organic priority pollutants analyzed and their respective detection limits are provided in Table D-7.

b. Landfill B. Analytical results for samples collected both upstream (SP 8) and downstream (SP 9) of Landfill B on Husky Brook are contained in Table D-2. Significant increases in those parameters associated with the brackish estuarine environment were detected at this location. These parameters were chloride, sulfate, hardness, conductivity, total dissolved solids (TDS), and sodium. A minor increase in color of 5 units was also observed. Gross beta increased by a mean of 2.4 pCi/L or 56 µCi/day based on a measured flow of 9.5 cfs. The properties of the statistical distribution of these differences indicate that there was just a 0.6 percent probability that there was no actual increase. However, the downstream concentration of 4.8 pCi/L was again well below the 50 pCi/L NIPDWR MCL and, therefore, was insignificant. Two organic priority pollutants were detected at both SP 8 and SP 9, but their concentrations did not increase across the landfill. This indicates that Landfill B was not the source of these parameters.

c. Landfill C. Table D-3 contains the analytical results for samples collected at SP 3, upstream of Landfill C, and at SP 4, downstream of the landfill on Lafetra Brook. The concentrations of the brackish water indicator parameters again increased due to the close proximity of the downstream sampling location to the estuary. Minor increases in total organic carbon, total suspended solids, ammonia and Kjeldahl nitrogens, phenols, turbidity, and odor, and a small decrease in pH, were also observed. Despite these

APPENDIX A

REFERENCES

1. State of New Jersey Department of Environmental Protection, Regulations concerning the New Jersey Pollutant Discharge Elimination System, N.J.A.C. 7:14A-1, et seq., March 1981.

2. Letter, this Agency, HSHB-EW-M, 2 July 1984, subject: Preliminary Report, Water Quality Engineering Study No. 32-24-0475-84, Stream Sampling for Landfill Discharge Determination, Fort Monmouth, New Jersey, 29 May - 7 June 1984.

3. TB MED 576, 15 March 1982, Sanitary Control and Surveillance of Water Supplies at Fixed Installations.

4. "Ground-water Resources of Monmouth County, New Jersey," Special Report No. 23, 1966, State of New Jersey Department of Conservation and Economic Development, Division of Water Policy and Supply.

5. "Installation Assessment of Fort Monmouth," Report No. 171, May 1980, US Army Toxic and Hazardous Materials Agency.

6. "Phase 1 Engineering Study and Compliance Plan, Fort Monmouth Solid Waste Landfill," 23 March 1981, William F. Cosulich Associates, P.C., Environmental Engineers.

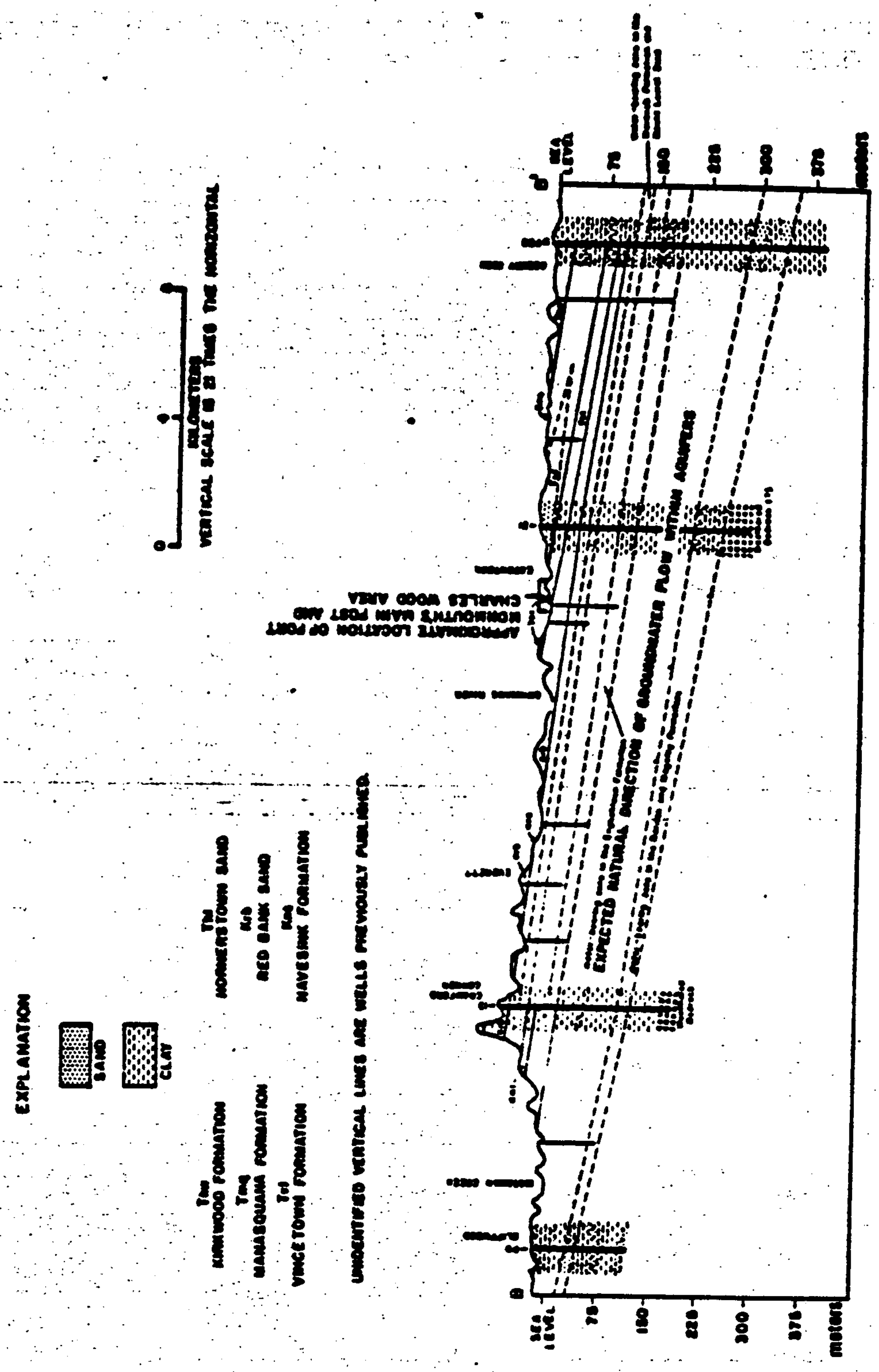

FIGURE C-2. Geologic Cross Section B-B' From Cliffwood Through Asbury Park (Source: reference 4, Appendix A).

TABLE. STRATIGRAPHIC UNITS OF THE NORTHERN ATLANTIC COASTAL PLAIN OF NEW JERSEY (Source: reference 5, Appendix A)

System	Series	Formation		Lithology
Quaternary	Holocene	Alluvium		Sand, silt, and black mud.
Quaternary	Holocene	Beach sand and gravel		Sand, quartz, light-colored, medium-grained, pebbly.
Quaternary	Pleistocene	Cape May Formation		Sand, quartz, light-colored, heterogeneous, clayey, pebbly, glauconitic.
Quaternary	Pleistocene	Pensauken Formation[2]		
Quaternary	Pleistocene	Bridgeton Formation		
Tertiary	Pliocene(?)	Beacon Hill Gravel		Gravel, quartz, light-colored, sandy.
Tertiary	Pliocene(?) and Miocene(?)	Cohansey Sand		Sand, quartz, light-colored, medium- to coarse-grained, pebbly; local clay beds.
Tertiary	Miocene	Kirkwood Formation		Sand, quartz, gray to tan, very fine- to medium-grained, micaceous, and dark-colored diatomaceous clay.
Tertiary	Eocene	Shark River Marl		Sand, quartz and glauconite, gray, brown, and green, fine- to coarse-grained, clayey, and green silty and sandy clay.
Tertiary	Eocene	Rancocas Group	Manasquan Formation	
Tertiary	Paleocene	Rancocas Group	Vincentown Formation	Sand, quartz, gray and green, fine- to coarse-grained, glauconitic, and brown clayey, very fossiliferous, glauconite and quartz calcarenite.
Tertiary	Paleocene	Rancocas Group	Hornerstown Sand	Sand, glauconite, green, medium- to coarse-grained, clayey.
Cretaceous	Upper Cretaceous	Monmouth Group	Tinton Sand and Red Bank Sand undivided	Sand, quartz and glauconite, brown and gray, fine- to coarse-grained, clayey, micaceous
Cretaceous	Upper Cretaceous	Monmouth Group	Navesink Formation	Sand, glauconite and quartz, green, black, and brown, medium- to coarse-grained, clayey
Cretaceous	Upper Cretaceous	Monmouth Group	Mount Laurel Sand	Sand, quartz, brown and gray, fine- to coarse-grained, glauconitic.
Cretaceous	Upper Cretaceous	Matawan Group	Wenonah Formation	Sand, quartz, gray and brown, very fine- to fine-grained, glauconitic, micaceous.
Cretaceous	Upper Cretaceous	Matawan Group	Marshalltown Formation	Sand, quartz and glauconite, gray and black, very fine- to medium-grained, very clayey.
Cretaceous	Upper Cretaceous	Matawan Group	Englishtown Formation	Sand, quartz, tan and gray, fine- to medium-grained; local clay beds.
Cretaceous	Upper Cretaceous	Matawan Group	Woodbury Clay	Clay, gray and black, micaceous.
Cretaceous	Upper Cretaceous	Matawan Group	Merchantville Formation	Clay, gray and black, micaceous, glauconitic, silty; locally very fine-grained quartz and glauconite sand.
Cretaceous	Upper Cretaceous	Magothy Formation		Sand, quartz, light-gray, fine-grained, and dark-grey lignitic clay.
Cretaceous	Upper Cretaceous	Raritan Formation		Sand, quartz, light-colored, fine- to coarse-grained, pebbly, arkosic, and red, white, and variegated clay.
Pre-Cretaceous				Precambrian and early Paleozoic crystalline rocks - metamorphic schist and gneiss; locally Triassic basalt, sandstone, and shale.

[1]Modified after Seaber, 1965.

[2]Age of Pensauken Formation now considered late Miocene.

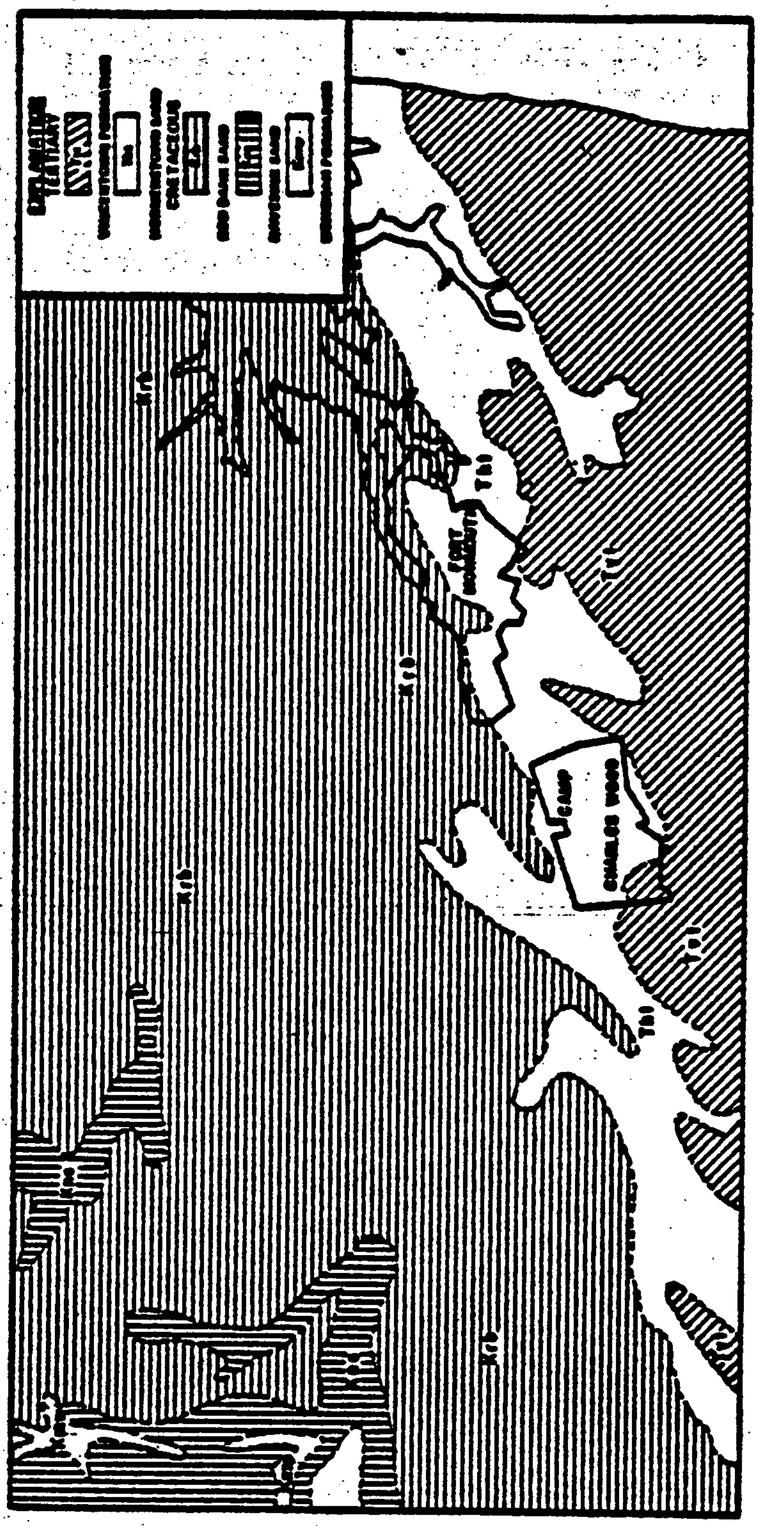

FIGURE C-3. Geologic Map of the Fort Monmouth Area (reference 5, Appendix A).

b. Hornerstown Sand Geohydrology. The Hornerstown Sand consists of clayey glauconite sand which ranges in thickness from 25 to 100 feet, with the thicker zone to the southeast. The unit dips to the southeast at 50 to 60 feet per mile. This unit is considered an aquiclude either independently or in conjunction with the lower member of the Red Bank Sand or the Navesink Formation. Landfills B and D are located in former marshes along Husky Brook and Mill Brook, respectively. The shallow ground water of the Hornerstown Sand is directly affected by wastes in these closed landfills. Predominant ground water flow from these areas is to the adjacent streams due to low the permeability of the Hornerstown Sand.

APPENDIX D

ANALYTICAL RESULTS

TABLE D-1. MEAN ANALYTICAL RESULTS - FORT MONMOUTH LANDFILL DISCHARGE DETERMINATION - LANDFILL A

Parameter (all units mg/L unless otherwise noted)	Upstream Concentration Sample Point 5	Downstream Concentration Sample Point 6	Increase Concentration	Increase lbs/day
Biochemical Oxygen Demand	<2	<2	-	-
Total Organic Carbon*	5.4	5.3	-	-
Chemical Oxygen Demand*	<25	<25	-	-
Total Suspended Solids	12	11	-	-
Ammonia-Nitrogen*	0.32	0.30	-	-
Kjeldahl Nitrogen*	0.69	0.67	-	-
Nitrate/Nitrite Nitrogen*	0.48	0.48	-	-
Cyanide*	<0.01	<0.01	-	-
Phenols*	0.01	<0.01	-	-
Chloride	38	37	-	-
Sulfate*	27	28	1	-
Fluoride*	0.11	<0.10	-	-
Surfactants	<0.05	<0.05	-	-
Color (Pt-Co units)	90	75	-	-
Hardness (as $CaCO_3$)	61.4	61.9	0.5	-
pH (standard units)	6.6	6.5	-0.1	-
Conductivity (µmhos/cm)	250	257	7	-
Total Dissolved Solids	165	165	-	-
Turbidity (nephelometric turbidity units)	20	20	-	-
Odor (threshold odor number)	<1.0	1.2	>0.2	-
Total Coliforms (#/100mL)	TNTC	240	-	-
Antimony	<0.5	<0.5	-	-
Arsenic	<0.01	<0.01	-	-
Barium	<0.3	<0.3	-	-
Beryllium	<0.05	<0.05	-	-
Cadmium	<0.001	<0.001	-	-
Chromium, total	<0.025	<0.025	-	-
Chromium, VI	<0.025	<0.025	-	-
Copper	<0.025	<0.025	-	-
Iron	3.33	3.35	0.02	1.3
Lead	<0.005	0.0055	>0.0005	>0.032
Manganese	0.07	0.07	-	-
Mercury	0.00543	0.0136	0.00817	0.520
Nickel	<0.1	<0.1	-	-
Selenium	0.0055	<0.005	-	-
Silver	<0.025	<0.025	-	-
Sodium	18.8	18.92	0.12	-
Thallium	<1	<1	-	-
Zinc	0.0294	0.0294	-	-
Organic Priority Pollutants†	None Detected	None Detected	-	-
Gross Alpha (pCi/L)	1.0 ± 0.8‡	<0.9	-	-
Gross Beta (pCi/L)	3.0 ± 0.9‡	3.8 ± 1.0‡	0.8 ± 1.3‡	23 ± 38§
Cesium-137 (pCi/L)	<12	<16	-	-

* Analyses performed after suggested holding time. Reported ammonia-nitrogen, Kjeldahl nitrogen, and phenol concentrations may be somewhat lower than actual values. Other parameters are not expected to be affected.
† See Table D-7 for a listing of organic priority pollutants and respective detection limits.
‡ pCi/L ± 2 standard deviations
§ µCi/day ± 2 standard deviations
TNTC - too numerous to count

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TABLE D-2. MEAN ANALYTICAL RESULTS - FORT MONMOUTH LANDFILL DISCHARGE DETERMINATION - LANDFILL B

Parameter (all units mg/L unless otherwise noted)	Upstream Concentration Sample Point 8	Downstream Concentration Sample Point 9	Increase Concentration	Increase lbs/day
Biochemical Oxygen Demand	<1	<1	-	-
Total Organic Carbon*	4.6	4.4	-	-
Chemical Oxygen Demand*	<25	<25	-	-
Total Suspended Solids	6	3	-	-
Ammonia-Nitrogen*	0.24	0.10	-	-
Kjeldahl Nitrogen*	0.46	0.46	-	-
Nitrate/Nitrite Nitrogen*	17	2.0	-	-
Cyanide*	<0.01	<0.01	-	-
Phenols*	<0.01	<0.01	-	-
Chloride	21	156	135	-
Sulfate*	25	35	10	-
Fluoride*	<0.10	<0.10	-	-
Surfactants	<0.05	<0.05	-	-
Color (Pt-Co units)	65	70	5	-
Hardness (as $CaCO_3$)	61.5	109.2	47.7	-
pH (standard units)	6.4	6.4	-	-
Conductivity (µmhos/cm)	193	662	469	-
Total Dissolved Solids	135	390	255	-
Turbidity (nephelometric turbidity units)	11	10	-	-
Odor (threshold odor number)	<1	<1	-	-
Total Coliforms (#/100mL)	260	TNTC	-	-
Antimony	<0.5	<0.5	-	-
Arsenic	<0.01	<0.01	-	-
Barium	<0.3	<0.3	-	-
Beryllium	<0.05	<0.05	-	-
Cadmium	<0.001	<0.001	-	-
Chromium, total	<0.025	<0.025	-	-
Chromium, VI	<0.025	<0.025	-	-
Copper	<0.025	<0.025	-	-
Iron	1.76	1.69	-	-
Lead	<0.005	<0.005	-	-
Manganese	0.07	0.07	-	-
Mercury	0.00421	0.00152	-	-
Nickel	<0.1	<0.1	-	-
Selenium	<0.005	<0.005	-	-
Silver	<0.025	<0.025	-	-
Sodium	9.77	76.45	66.68	-
Thallium	<1	<1	-	-
Zinc	0.0281	0.0281	-	-
1,2 Dichloroethene (trans)†	0.010	0.008	-	-
Trichloroethylene†	0.019	0.015	-	-
Gross Alpha (pCi/L)	<0.7	<2.0	-	-
Gross Beta (pCi/L)	2.4 ± 0.9‡	4.8 ± 1.7‡	2.4 ± 1.9‡	56 ± 44§
Cesium-137 (pCi/L)	<4.2	<15	-	-

* Analyses performed after suggested holding time. Reported ammonia-nitrogen, Kjeldahl nitrogen, and phenol concentrations may be somewhat lower than actual values. Other parameters are not expected to be affected.

† Only organic priority pollutants detected. See Table D-7 for a listing of all organic pollutants and respective detection limits.

‡ pCi/L ± 2 standard deviations

§ µCi/day ± 2 standard deviations

TNTC - too numerous to count

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TABLE D-3. MEAN ANALYTICAL RESULTS - FORT MONMOUTH LANDFILL DISCHARGE DETERMINATION - LANDFILL C

Parameter (all units mg/L unless otherwise noted)	Upstream Concentration Sample Point 3	Downstream Concentration Sample Point 4	Increase Concentration	Increase lbs/day
Biochemical Oxygen Demand	<1	<1	-	-
Total Organic Carbon*	4.8	4.9	0.1	2
Chemical Oxygen Demand*	<25	<25	-	-
Total Suspended Solids	4	7	3	50
Ammonia-Nitrogen*	0.08	0.50	0.42	6.3
Kjeldahl Nitrogen*	0.39	0.88	0.49	7.4
Nitrate/Nitrite Nitrogen*	0.58	0.48	-	-
Cyanide*	<0.01	<0.01	-	-
Phenols*	<0.01	0.01	<0.01	<0.2
Chloride	26	30	4	-
Sulfate*	26	27	1	-
Fluoride*	<0.10	<0.10	-	-
Surfactants	<0.05	<0.05	-	-
Color (Pt-Co units)	65	105	40	-
Hardness (as $CaCO_3$)	70.5	84.9	14.4	-
pH (standard units)	6.8	6.6	-0.2	-
Conductivity (µmhos/cm)	229	277	48	-
Total Dissolved Solids	160	175	15	-
Turbidity (nephelometric turbidity units)	12	17	5	-
Odor (threshold odor number)	<1	2.0	>1.0	-
Total Coliforms (#/100mL)	TNTC	TNTC	-	-
Antimony	<0.5	<0.5	-	-
Arsenic	<0.01	<0.01	-	-
Barium	<0.3	<0.3	-	-
Beryllium	<0.05	<0.05	-	-
Cadmium	<0.001	<0.001	-	-
Chromium, total	<0.025	<0.025	-	-
Chromium, VI	<0.025	<0.025	-	-
Copper	<0.025	<0.025	-	-
Iron	2.4	3.6	1.2	18
Lead	<0.005	<0.005	-	-
Manganese	0.07	0.09	0.02	0.30
Mercury	0.0115	0.0106	-	-
Nickel	<0.1	<0.1	-	-
Selenium	<0.005	<0.005	-	-
Silver	<0.025	<0.025	-	-
Sodium	12.1	14.68	2.58	-
Thallium	<1	<1	-	-
Zinc	<0.015	<0.015	-	-
Organic Priority Pollutants†	None Detected	None Detected	-	-
Gross Alpha (pCi/L)	<0.8	<0.9	-	-
Gross Beta (pCi/L)	2.9 ± 0.9 ‡	3.5 ± 0.9 ‡	0.6 ± 1.3 ‡	4.1 ± 8.9§
Cesium-137 (pCi/L)	<16	<16	-	-

* Analyses performed after suggested holding time. Reported ammonia and Kjeldahl nitrogen and phenol concentrations may be somewhat lower than actual values. Other parameters are not expected to be affected.
† See Table D-7 for a listing of organic priority pollutants and respective detection limits.
‡ pCi/L ± 2 standard deviations
§ µCi/day ± 2 standard deviations
TNTC - too numerous to count

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TABLE D-4. MEAN ANALYTICAL RESULTS - FORT MONMOUTH LANDFILL DISCHARGE DETERMINATION - LANDFILL D

Parameter (all units mg/L unless otherwise noted)	Upstream Concentration Sample Point 1	Downstream Concentration Sample Point 2	Increase Concentration	Increase lbs/day
Biochemical Oxygen Demand	<1	<1	-	-
Total Organic Carbon*	5.6	5.2	-	-
Chemical Oxygen Demand*	<25	<25	-	-
Total Suspended Solids	4	9	5	300
Ammonia-Nitrogen*	0.24	0.30	0.06	4
Kjeldahl Nitrogen*	0.59	0.55	-	-
Nitrate/Nitrite Nitrogen*	0.41	0.47	0.06	4
Cyanide*	<0.01	<0.01	-	-
Phenols*	<0.01	<0.01	-	-
Chloride	36	36	-	-
Sulfate*	27	27	-	-
Fluoride*	<0.10	<0.10	-	-
Surfactants	<0.05	<0.05	-	-
Color (Pt-Co units)	80	75	-	-
Hardness (as $CaCO_3$)	64.9	64.3	-	-
pH (standard units)	6.7	6.7	-	-
Conductivity (μmhos/cm)	253	253	-	-
Total Dissolved Solids	165	170	5	-
Turbidity (nephelometric turbidity units)	15	17	2	-
Odor (threshold odor number)	<1	1.2	>0.2	-
Total Coliforms (#/100mL)	TNTC	TNTC	-	-
Antimony	<0.5	<0.5	-	-
Arsenic	<0.01	<0.01	-	-
Barium	<0.3	<0.3	-	-
Beryllium	<0.05	<0.05	-	-
Cadmium	<0.001	<0.001	-	-
Chromium, total	<0.025	<0.025	-	-
Chromium, VI	<0.025	<0.025	-	-
Copper	<0.025	<0.025	-	-
Iron	2.48	2.71	0.23	15
Lead	<0.005	<0.005	-	-
Manganese	0.07	0.07	-	-
Mercury	0.00359	<0.0002	-	-
Nickel	<0.1	<0.1	-	-
Selenium	<0.005	<0.005	-	-
Silver	<0.025	<0.025	-	-
Sodium	18.51	19.42	0.91	-
Thallium	<1	<1	-	-
Zinc	0.0252	0.0252	-	-
Organic Priority Pollutants†	None Detected	None Detected	-	-
Gross Alpha (pCi/L)	1.0 ± 0.8 ‡	<0.9	-	-
Gross Beta (pCi/L)	3.0 ± 0.8 ‡	3.1 ± 0.9‡	0.1 ± 1.2 ‡	2.9 ± 34§
Cesium-137 (pCi/L)	<4.2	<14	-	-

* Analyses performed after suggested holding time. Reported ammonia-nitrogen, Kjeldahl nitrogen, and phenol concentrations may be somewhat lower than actual values. Other parameters are not expected to be affected.
† See Table D-7 for a listing of organic priority pollutants and respective detection limits.
‡ pCi/L ± 2 standard deviations
§ μCi/day ± 2 standard deviations
TNTC - too numerous to count

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TABLE D-5. MEAN ANALYTICAL RESULTS - FORT MONMOUTH LANDFILL DISCHARGE DETERMINATION - LANDFILL E

Parameter (all units mg/L unless otherwise noted)	Upstream Concentration Sample Point - 4	6	Downstream Concentration Sample Point 7	Increase Concentration	lbs/day
Biochemical Oxygen Demand	<1	<2	<1	-	-
Total Organic Carbon*	4.9	5.3	5.1	-	-
Chemical Oxygen Demand*	<25	<25	<25	-	-
Total Suspended Solids	7	11	10	-	-
Ammonia-Nitrogen*	0.50	0.30	0.24	-	-
Kjeldahl Nitrogen*	0.88	0.67	0.69	-	-
Nitrate/Nitrite Nitrogen*	0.48	0.48	0.54	<0.06	<10
Cyanide*	<0.01	<0.01	<0.01	-	-
Phenols*	0.01	<0.01	<0.01	-	-
Chloride	30	37	38	-	-
Sulfate*	27	28	28	-	-
Fluoride*	<0.10	<0.10	<0.10	-	-
Surfactants	<0.05	<0.05	<0.05	-	-
Color (Pt-Co units)	105	75	85	-	-
Hardness (as $CaCO_3$)	84.9	61.9	70.1	-	-
pH (standard units)	6.6	6.5	6.5	-	-
Conductivity (μmhos/cm)	277	257	291	<30	-
Total Dissolved Solids	175	165	170	-	-
Turbidity (nephelometric turbidity units)	17	20	15	-	-
Odor (threshold odor number)	2.0	1.2	1.4	-	-
Total Coliforms (#/100mL)	TNTC	240	510	-	-
Antimony	<0.5	<0.5	<0.5	-	-
Arsenic	<0.01	<0.01	<0.01	-	-
Barium	<0.3	<0.3	<0.3	-	-
Beryllium	<0.05	<0.05	<0.05	-	-
Cadmium	<0.001	<0.001	<0.001	-	-
Chromium, total	<0.025	<0.025	<0.025	-	-
Chromium, VI	<0.025	<0.025	<0.025	-	-
Copper	<0.025	<0.025	<0.025	-	-
Iron	3.6	3.35	2.49	-	-
Lead	<0.005	0.0055	0.005	-	-
Manganese	0.09	0.07	0.07	-	-
Mercury	0.0106	0.0136	0.00221	-	-
Nickel	<0.1	<0.1	<0.1	-	-
Selenium	<0.005	<0.005	<0.005	-	-
Silver	<0.025	<0.025	<0.025	-	-
Sodium	14.68	18.92	22.34	<9.4	-
Thallium	<1	<1	<1	-	-
Zinc	<0.015	0.0294	0.0167	<0.010	<2.1
Organic Priority Pollutants†	None Detected	None Detected	None Detected	-	-
Gross Alpha (pCi/L)	<0.9	<0.9	<1.0	-	-
Gross Beta (pCi/L)	3.5 ± 0.9‡	3.8 ± 1.0‡	3.2 ± 0.9‡	-	-
Cesium-137 (pCi/L)	<16	<16	<12	-	-

* Analyses performed after suggested holding time. Reported ammonia-nitrogen, Kjeldahl nitrogen, and phenol concentrations may be somewhat lower than actual values. Other parameters are not expected to be affected.
† See Table D-7 for a listing of organic priority pollutants and respective detection limits.
‡ pCi/L ± 2 standard deviations
TNTC - too numerous to count

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TABLE D-6. MEAN ANALYTICAL RESULTS - FORT MONMOUNT LANDFILL DISCHARGE DETERMINATION

Parameter (all units mg/L unless otherwise noted)	Upstream Concentration Sample Point 10	Downstream Concentration Sample Point 8
Biochemical Oxygen Demand	1	<1
Total Organic Carbon*	4.4	4.6
Chemical Oxygen Demand*	<25	<25
Total Suspended Solids	7	6
Ammonia-Nitrogen*	<0.10	0.24
Kjeldahl Nitrogen*	<0.10	0.46
Nitrate/Nitrite Nitrogen*	1.5	17
Cyanide*	<0.01	<0.01
Phenols*	<0.01	<0.01
Chloride	23	21
Sulfate*	26	25
Fluoride*	<0.10	<0.10
Surfactants	-	<0.05
Color (Pt-Co units)	75	65
Hardness (as $CaCO_3$)	70.0	61.5
pH (standard units)	-	6.4
Conductivity (µmhos/cm)	-	193
Total Dissolved Solids	168	135
Turbidity (nephelometric turbidity units)	11	11
Odor (threshold odor number)	-	<1
Total Coliforms (#/100mL)	-	260
Antimony	<0.5	<0.5
Arsenic	<0.01	<0.01
Barium	<0.3	<0.3
Beryllium	<0.05	<0.05
Cadmium	0.0012	<0.001
Chromium, total	<0.025	<0.025
Chromium, VI	<0.025	<0.025
Copper	<0.025	<0.025
Iron	1.88	1.76
Lead	<0.005	<0.005
Manganese	0.06	0.07
Mercury	0.00184	0.00421
Nickel	<0.1	<0.1
Selenium	<0.005	<0.005
Silver	<0.025	<0.025
Sodium	13.09	9.77
Thallium	<1	<1
Zinc	0.0336	0.0281
1,2 Dichloroethene (trans)†	0.020	0.010
Tetrachloroethylene†	0.003	<0.003
Trichloroethylene†	0.036	0.019

* Analyses performed after suggested holding time. Reported ammonia-nitrogen, Kjeldahl nitrogen, and phenol concentrations may be somewhat lower than actual values. Other parameters are not expected to be affected.
† Only organic priority pollutants detected. See Table D-7 for a listing of all organic priority pollutants and respective detection limits.

J. David Turnbull

J. DAVID TURNBULL
MAJ, MS
Director, Laboratory Services

Pesticides/Polychlorinated Biphenyls	Limit of Detection (µg/L)
BHC (Alpha)	20
BHC (Beta)	20
BHC (Gamma)	20
BHC (Delta)	20
Heptachlor	20
Aldrin	20
Heptachlor Epoxide	20
4,4'-DDE	20
Dieldrin	20
Endrin	20
4,4'-DDD	20
4,4'-DDT	20
Endosulfan Sulfate	20
Endosulfan I	20
Endosulfan II	20
Chlordane	20
Toxaphene	500
Endrin Aldehyde	20
PCB 1016	50
PCB 1221	50
PCB 1232	50
PCB 1242	50
PCB 1248	50
PCB 1254	50
PCB 1260	50

Volatile Organics	Limit of Detection (µg/L)
Benzene	3
Bromomethane	3
Bromodichloromethane	3
Bromoform	3
Carbon Tetrachloride	3
Chlorobenzene	3
Chloroethane	3
2-Chloroethylvinyl Ether	3
Chloroform	3
Chloromethane	3
Dibromochloromethane	3
1,1-Dichloroethane	3
1,2-Dichloroethane	3
1,1-Dichloroethene	3
1,2-Dichloroethene (Trans)	3
1,2-Dichloropropane	3
1,3-Dichloropropene (Cis)	3
1,3-Dichloropropene (Trans)	3
Ethyl Benzene	3
Methylene Chloride	3
1,1,2,2-Tetrachloroethane	3
Tetrachloroethylene	3
1,1,1-Trichloroethane	3
1,1,2-Trichloroethane	3
Trichloroethylene	3
Trichlorofluoromethane	3
Toluene	3
Vinyl Chloride	3

APPENDIX E

ANALYTICAL METHODOLOGIES

Parameter	Reference	Description
Total Organic Carbon	EPA 415.1*	Combustion, infrared
Chemical Oxygen Demand	EPA 410.2*	Low level, dichromate reflux
Biochemical Oxygen Demand	EPA 405.1*	5-day, 20°C
Total Suspended Solids	EPA 160.2*	Gravimetric, dried at 103-105°C
Total Dissolved Solids	EPA 160.1*	Gravimetric, dried at 180°C
Turbidity	EPA 180.1*	Nephelometric
pH	EPA 150.1*	Electrochemical
Conductivity	SM 205†	Wheatstone bridge conductivity
Ammonia-Nitrogen	EPA 350.2*	Spectrophoto., following distillation
Kjeldahl Nitrogen	EPA 351.3*	Spectrophotometric
Nitrate/Nitrite-Nitrogen	EPA 353.2*	Automated, cadmium reduction
Cyanide, total	EPA 335.2*	Spectrophoto., manual distillation
Phenols, total	EPA 420.1*	Spectrophoto., manual distillation
Chloride	SM 408B†	Titrimetric, mercuric nitrate
Sulfate	EPA 375.2*	Automated, methyl thymol blue
Fluoride	EPA 340.2*	Electrochm., ion selective electrode
Surfactants	SM 512A†	Spectrophotometric, MBAS
Color	EPA 110.2*	Colorimetric, platinum-cobalt
Hardness	SM 309A†	Computation from Ca and Mg
Odor	EPA 140.1*	Threshold odor, consistent series
Total Coliforms	SM 909†	Membrane filter
Antimony	EPA 204.1*	Atomic absorption, direct aspiration
Arsenic	EPA 206.2*	Atomic absorption, furnace technique
Barium	EPA 208.1*	Atomic absorption, direct aspiration
Beryllium	EPA 210.1*	Atomic absorption, direct aspiration
Cadmium	EPA 213.2*	Atomic absorption, furnace technique
Chromium, total	EPA 218.1*	Atomic absorption, direct aspiration
Chromium, hexavalent	EPA 218.4*	Atomic absorption, chelation-extrac.
Copper	EPA 220.1*	Atomic absorption, direct aspiration
Iron	EPA 236.1*	Atomic absorption, direct aspiration
Lead	EPA 239.2*	Atomic absorption, furnace technique
Manganese	EPA 243.1*	Atomic absorption, direct aspiration
Mercury	EPA 245.1*	Manual cold vapor technique
Nickel	EPA 249.1*	Atomic absorption, direct aspiration
Selenium	EPA 270.2*	Atomic absorption, furnace technique
Silver	EPA 272.1*	Atomic absorption, direct aspiration
Sodium	EPA 273.1*	Atomic absorption, direct aspiration
Thallium	EPA 279.1*	Atomic absorption, direct aspiration
Zinc	EPA 289.1*	Atomic absorption, direct aspiration
Volatile Organics	EPA 624‡	Purge and Trap, GC/MS
Base/Neutral Extractables	EPA 625‡	Methylene Chloride Extraction, GC/MS
Acid Extractables	EPA 625‡	Methylene Chloride Extraction, GC/MS
Pesticides/PCBs	EPA 625‡	Methylene Chloride Extraction, GC/MS
Gross Alpha Emitters	EPAR 900.0§	Gas flow proportional counter
Gross Beta Emitters	EPAR 900.0§	Gas flow proportional counter
Cesium-137	EPAR 900.1§	GeLi detector counter

* EPA - EPA Methods for Chemical Analysis of Water and Wastes, EPA 600-4-79-020, March 1983.
†SM - Standard Methods for the Examination of Water and Wastewater, 15th edition, 1983.
‡ Proposed Regulatory Guidelines Establishing Test Procedures for the Analysis of Pollutants, 44 Federal Register (FR) 69464, 3 December 1979, as corrected by 44 FR 75028, 18 December 1979.
§ EPAR - Prescribed Procedures for Measurement of Radioactivity of Drinking Water, EPA 600/4-80-030, August 1980.

DEPARTMENT OF THE ARMY
U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

Mr. Resch/slw/AUTOVON
584-3554

REPLY TO
ATTENTION OF

14 DEC 1984

HSHB-EW-M/WP

SUBJECT: Water Quality Engineering Study No. 32-24-0475-85, Stream Sampling For Landfill Discharge Determination, Fort Monmouth, New Jersey, 29 May - 7 June 1984

Commander
US Army Materiel Command
ATTN: AMCSG
5001 Eisenhower Avenue
Alexandria, VA 22333-0001

EXECUTIVE SUMMARY

1. The purpose, essential findings, and major recommendation of the enclosed report follow:

a. Purpose. To determine if leachate from Fort Monmouth landfills is entering adjacent waterways.

b. Essential Findings. The only significant contamination potentially attributable to landfill leachate was an increase in mercury in Mill Brook adjacent to Landfill A. Although changes in the concentrations of several parameters were also detected at three of the other four landfills, all changes were minor and of negligible importance. In total, the landfills are having minimal impact on the streams flowing through Fort Monmouth.

c. Major Recommendations.

(1) Present the analytical results and conclusions contained in the enclosed report to the New Jersey Department of Environmental Protection in compliance with the New Jersey Pollutant Discharge Elimination System regulations.

(2) Resample at Landfill A to determine the validity of the mercury results.

2. Additional copies of this report are inclosed for mailing to HQDA(DAEN-ZCF-U), HQDA(DAEN-ZCE), and Commandant, Academy of Health Sciences (HSHA-IPM).

FOR THE COMMANDER:

Karl J. Daubel

Encl

KARL J. DAUBEL
Colonel, MS
Director, Environmental Quality

CF:
HQDA(DASG-PSP) (wo/encl)
Cdr, CECOM (w/encl)
Cdr, HSC (HSCL-P) (w/encl)
Cdr, Fort Monmouth (2 cy) (w/encl)
Cdr, WRAMC (PVNTMED Svc) (w/encl)
Cdr, MEDDAC, Ft Monmouth (PVNTMED Svc) (2 cy) (w/encl)
C, USAEHA-Rgn Div North (w/encl)

214 B

ENCLOSURE w/ letter

DEPARTMENT OF THE ARMY
U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

Mr. Resch/emw/AUTOVON 584-3554

REPLY TO ATTENTION OF

HSHB-EW-M

15 MAR 1985

SUBJECT: Addendum, Water Quality Engineering Study No. 32-24-0475-85, Stream Sampling for Landfill Discharge Determination, Fort Monmouth, New Jersey, 29 May - 7 June 1984

Commander
US Army Materiel Command
ATTN: AMCSG
5001 Eisenhower Avenue
Alexandria, VA 22333-0001

1. AUTHORITY. Letter, Fort Monmouth, SELHI-EH-EV, undated, subject: Water Quality Survey for Streams Affected by Sanitary Landfill Leachate on Fort Monmouth, with initial endorsement, HQ, DARCOM, DRCSG-E, 20 January 1984.

2. REFERENCES.

a. Letter, this Agency, HSHB-EW-M/WP, 14 December 1984, subject: Water Quality Engineering Study No. 32-24-0475-85, Stream Sampling for Landfill Discharge Determination, Fort Monmouth, New Jersey, 29 May - 7 June 1984.

b. US Environmental Protection Agency, Quality Criteria For Water, July 1976.

c. FONECON between Mr. Bob Runyon, New Jersey Department of Environmental Protection (NJDEP), and Mr. Michael Resch, this Agency, 8 February 1985, subject: Ambient Mercury Levels in Surface Waters in the Fort Monmouth Area.

3. PURPOSE. To determine if mercury results at Landfill A, reported in the referenced letter, were correct.

4. BACKGROUND.

a. There are five closed sanitary landfills at Fort Monmouth located in low-lying areas adjacent to streams. It has been assumed that the materials contained in these landfills are either in very close proximity to or in direct contact with the ground water. Therefore, it has been further assumed that if any landfill leachate is being released, the contaminated ground water would be discharged into the adjacent stream channels. Regulations of the NJDEP specifically prohibit the unpermitted point source discharge of leachate, either to ground water or surface waters.

6. CONCLUSION. The average concentration of mercury in Mill Brook adjacent to Landfill A is less than 0.2 ug/L. The results of the June 1984 sampling were erroneous.

7. RECOMMENDATION. The following recommendation is based on good engineering practice. Present the analytical results and conclusions contained in this study to the NJDEP in compliance with applicable regulations.

8. TECHNICAL ASSISTANCE. Requests for services should be directed through appropriate command channels of the requesting activity to the Commander, US Army Environmental Hygiene Agency, ATTN: HSHB-EW-M, Aberdeen Proving Ground, MD 21010-5422, with an information copy furnished to the Commander, US Army Health Services Command, ATTN: HSCL-P, Fort Sam Houston, TX 78234-6000.

FOR THE COMMANDER:

Karl J. Daubel

KARL J. DAUBEL
Colonel, MS
Director, Environmental Quality

CF:
HQDA(DASG-PSP)
Cdr, CECOM
Cdr, HSC (HSCL-P)
Cdr, Fort Monmouth (2 cy)
Cdr, WRAMC (PVNTMED Svc)
Cdr, MEDDAC, Ft Monmouth (PVNTMED Svc) (2 cy)
C, USAEHA - Rgn Div North

AEHA

UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, MD 21010-5422

WATER QUALITY ENGINEERING STUDY NO. 32-24-0475-85
STREAM SAMPLING FOR LANDFILL DISCHARGE DETERMINATION
FORT MONMOUTH, NEW JERSEY
29 MAY - 7 JUNE 1984

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

HSHB-EW-M/WP

WATER QUALITY ENGINEERING STUDY NO. 32-24-0475-85 STREAM SAMPLING FOR LANDFILL DISCHARGE DETERMINATION FORT MONMOUTH, NEW JERSEY 29 MAY - 7 JUNE 1984

1. AUTHORITY. Letter, Fort Monmouth, SELHI-EH-EV, undated, subject: Water Quality Survey for Streams Affected by Sanitary Landfill Leachate on Fort Monmouth, with initial endorsement, HQ, DARCOM, DRCSG-E, 20 January 1984.

2. REFERENCES. References are contained in Appendix A.

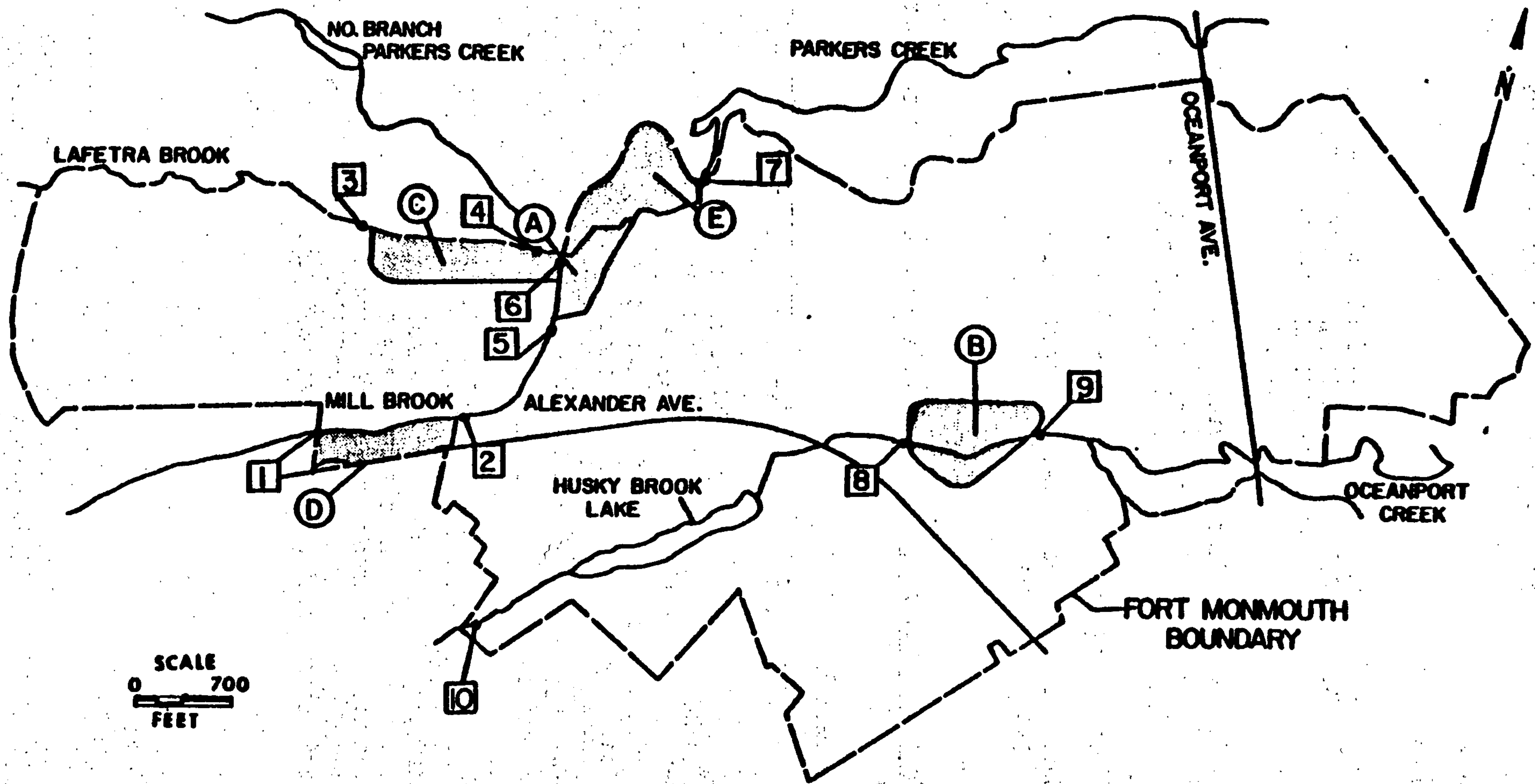
3. PURPOSE. To determine if leachate from Fort Monmouth landfills is entering adjacent waterways.

4. GENERAL.

a. Personnel Contacted. See Appendix B for a listing of personnel contacted.

b. Background.

(1) Five distinct locations at Fort Monmouth have been utilized as solid waste landfills since 1940. All landfills are now closed, with the dumping of trash at the last site terminated in 1980. Since that time, the installation has been transporting all solid waste offpost for disposal. Each landfill, labeled A through E in the following Figure, is located in a low-lying area adjacent to one of the streams which flows through the installation. These locations were presumably very wet and marshy prior to dumping, with four landfills being sited in tidal areas. It has, therefore, been assumed that the landfilled materials are either in very close proximity to or in direct contact with the ground water, especially at higher tidal conditions. Furthermore, if leachate is emanating from any of the landfills, it is suspected that natural ground-water flow toward the adjacent stream channels (particularly during falling tides) will result in the discharge of contaminated ground water into these channels. Personnel of this Agency, therefore, believe that analysis of stream samples collected at carefully selected locations and under proper tidal conditions will indicate whether leachate sources exist at any of the landfills. A detailed description of geohydrologic considerations is provided in Appendix C.



LEGEND

1 SAMPLE POINT NUMBER

A LANDFILL

FIGURE

FORT MONMOUTH LANDFILLS

AND SAMPLE POINT LOCATIONS

Water Quality Engr Study No. 32-24-0475-85, Ft Monmouth, NJ, 29 May - 7 Jun 84

(2) The State of New Jersey Department of Environmental Protection (NJDEP) established the New Jersey Pollutant Discharge Elimination System (NJPDES) regulations in March 1981 (reference 1, Appendix A). These regulations not only prohibit the unpermitted point source discharge of pollutants to surface water, but also unpermitted discharges of pollutants to the ground water. The discharge of leachate to the ground water from both closed landfills and those currently in operation are specifically covered by these regulations. The NJDEP has requested Fort Monmouth to investigate the potential for ground-water or surface-water contamination by the above-mentioned landfills.

c. Survey Execution.

(1) Ten sampling points (SP's) were selected. As shown in the Figure, one SP was upstream from each landfill and one SP was downstream of each landfill. Since landfills A, C, and E are adjacent to one another, and since the same streams border all three, the downgradient SP's for A and C serve as the upgradient SP for E. Sample point 10 was chosen to depict Husky Brook water quality at the location where that stream enters the installation.

(2) As previously stated, most of the streams are affected by tides. In order to meet the tidal sampling requirements outlined above, sampling was accomplished during the period between high and low tides while the stream levels were declining. This was accomplished with the assumption that this condition would approximate worst-case conditions.

(3) Sampling occurred over a 3-day period. On each day, samples taken at each SP for biochemical oxygen demand, surfactants, total coliforms, turbidity, and color were obtained. These samples were packaged and shipped to the Directorate of Laboratory Services, this Agency for analyses. One grab sample was collected at each SP for hexavalent chromium, odor, pesticides, and all organic priority pollutants. Additionally, 3 days of sampling were composited into one sample at each SP for analyses of numerous other metal and nonmetal parameters. Summaries of analytical results are provided in Appendix D. Analytical methodologies are contained in Appendix E.

(4) Each day at each sample point, several physical stream characteristics were obtained - channel depth, channel width, and stream velocity. In addition, pH and conductivity were measured daily at each location.

(5) This study was performed by Michael E. Resch, P.E.; Mark D. Nickelson; and Stephen L. Kistner, P.E.; Water Quality Engineering Division; and Wayne A. Fox, Waste Disposal Engineering Division, this Agency.

(6) The preliminary findings of this study are contained in reference 2, Appendix A.

5. FINDINGS AND DISCUSSION.

a. Landfill A. Table D-1 contains the analytical results for samples collected both upstream (SP 5) and downstream (SP 6) of Landfill A on Mill Brook. Minor changes in concentrations of several parameters across the landfill were observed. The minor increases in the levels of sulfate, hardness, conductivity, and sodium were due to the increased salinity of the stream as sample collection sites approached the downstream estuary. Additional minor changes were a decrease in pH of 0.1 unit and an increase in odor from less than 1.0 to 1.2 threshold odor numbers. Concentrations of three different metals increased across Landfill A. These increased concentrations were mathematically converted to increased loadings in pounds per day (lbs/day) utilizing the measured flow rate of 11.8 cubic feet per second (cfs). These increases were 0.02 milligrams/liter (mg/L) (1.3 lbs/day) iron, 0.5 micrograms/liter (µg/L) (0.03 lbs/day) of lead, and 8 µg/L (0.52 lbs/day) of mercury. This increase in mercury was the only significant change detected for any metal across this landfill. If a source of leachate was present, significant increases in the concentrations of several metals could be anticipated. Since this was not the case in this situation, resampling at this location will indicate if the reported mercury results were erroneous. The gross beta radionuclides increased by a mean of 0.8 picocuries/liter (pCi/L) or a loading of 23 microcuries/day (µCi/day). Given the statistical distribution of the reported mean differences, there was an 11-percent probability that there was no actual increase in gross beta concentration. The downstream concentration of 3.8 pCi/L was well below the National Interim Primary Drinking Water regulations (NIPDWR) maximum contaminant level (MCL) of 50 pCi/L (see reference 3, Appendix A). As such, this increase was considered to be insignificant. No organic priority pollutants were detected. The list of all organic priority pollutants analyzed and their respective detection limits are provided in Table D-7.

b. Landfill B. Analytical results for samples collected both upstream (SP 8) and downstream (SP 9) of Landfill B on Husky Brook are contained in Table D-2. Significant increases in those parameters associated with the brackish estuarine environment were detected at this location. These parameters were chloride, sulfate, hardness, conductivity, total dissolved solids (TDS), and sodium. A minor increase in color of 5 units was also observed. Gross beta increased by a mean of 2.4 pCi/L or 56 µCi/day based on a measured flow of 9.5 cfs. The properties of the statistical distribution of these differences indicate that there was just a 0.6 percent probability that there was no actual increase. However, the downstream concentration of 4.8 pCi/L was again well below the 50 pCi/L NIPDWR MCL and, therefore, was insignificant. Two organic priority pollutants were detected at both SP 8 and SP 9, but their concentrations did not increase across the landfill. This indicates that Landfill B was not the source of these parameters.

c. Landfill C. Table D-3 contains the analytical results for samples collected at SP 3, upstream of Landfill C, and at SP 4, downstream of the landfill on Lafetra Brook. The concentrations of the brackish water indicator parameters again increased due to the close proximity of the downstream sampling location to the estuary. Minor increases in total organic carbon, total suspended solids, ammonia and Kjeldahl nitrogens, phenols, turbidity, and odor, and a small decrease in pH, were also observed. Despite these increases, downstream concentrations for each of these parameters were still within acceptable levels. A substantial increase in color of 40 units was observed. Additionally, iron increased 1.2 mg/L (18 lbs/day based on a measured flow of 2.8 cfs), and manganese increased 0.02 mg/L (0.3 lbs/day) across the landfill. Gross beta increased on average 0.6 pCi/L (4.1 µCi/day) to 3.5 pCi/L. Statistically, there was an 18-percent probability that there was no actual increase in this parameter. As before, the recorded concentrations were well below the NIPDWR MCL for gross beta activity. No organic priority pollutants were detected at either sampling location.

d. Landfill D. Table D-4 contains the analytical results for samples collected both upstream (SP 1) and downstream (SP 2) of Landfill D on Mill Brook. Two of the brackish water parameters, sodium and TDS, experienced minor increases across the landfill. Minor increases were also detected in the concentrations of total suspended solids, ammonia and nitrate/nitrite nitrogens, turbidity, and odor. The only metal to increase downstream was iron at 0.23 mg/L (15 lbs/day based on a measure flow of 11.7 cfs). Gross beta increased an average of 0.1 pCi/L (2.9 µCi/day) to 3.1 pCi/L, well below the NIPDWR MCL. Statistically, there was a 43-percent probability that there was no actual increase in this parameter. No organic priority pollutants were detected at either SP.

e. Landfill E. Analytical results for the Landfill E SP's are contained in Table D-5. As shown in the Figure, three separate streams join to form Parker's Creek which flows along the side of Landfill E. The sampling locations upstream of this landfill were SP 4 at the mouth of Lafetra Brook and SP 6 at the mouth of Mill Brook. The North Branch of Parker's Creek drains the area north of the Fort Monmouth reservation and flows into Parker's Creek below the confluence of Lafetra and Mill Brooks. Sampling could not be accomplished at the North Branch because of its inaccessibility from the installation property. The flows measured at SP's 4 and 6 were 2.8 cfs and 11.8 cfs, respectively. The flow measured at the downstream SP 7 was 38.5 cfs. Therefore, the flow from the North Branch Parker's Creek was 23.9 cfs. The analytical results for SP's 4 and 6, upstream of Landfill E, and SP 7, downstream of the landfill, are contained in Table D-5. Because of the unknown chemical quality of the North Branch, increases in concentrations of each parameter across the landfill cannot be determined with assurance. However, the assumption was made that the North Branch will be similar in quality to the other streams at the SP's upstream of the landfills. Implied in this assumption is the further assumption that no unnatural sources of any of the chemical parameters were present on the North Branch. These assumptions will yield the worst-case results by providing the maximum reasonable quantity of each parameter which the landfilled materials could have been added to the stream. Given the above reasoning, only four parameters actually increased across Landfill E. The sodium and conductivity increases are due to the increased salinity of SP 7. Additionally, minor increases in the levels of nitrate/nitrite nitrogen and zinc were detected. No organic priority pollutants were detected at any of the SP's.

f. Sample Point 10. Sample Point 10 was chosen to depict the Husky Brook water quality at the location where that stream enters the installation. The analytical results from samples collected at this SP are compared to those reported from SP 8 downstream. Concentrations of cadmium, zinc and tetrachloroethylene at SP 10 were somewhat higher than those at SP 8 as well as the other SP's utilized in this study. All other parameters were detected at concentrations similar to those observed at the other sampling locations.

6. CONCLUSIONS.

a. The concentrations of chloride, sulfate, hardness, conductivity, TDS, and sodium increased across most of the landfills. However, these changes were most likely due to the increased salinity of the streams as sample collection sites approached the downstream estuaries, and not attributable to landfill leachate sources.

b. A significant increase in the concentration of mercury across Landfill A was probably attributable to leachate from this landfill barring laboratory and/or sampling error. Minor changes in the concentrations of several other parameters, although potentially traceable to the effects of the landfill, were of negligible importance.

c. No changes in stream quality across Landfill B were attributable to landfill leachate.

d. A significant increase in color was detected across Landfill C. However, because all other changes were very minor, no appreciable source of leachate is believed to be emanating from this landfill.

e. Minor changes in the concentrations of several parameters across Landfill D, although potentially traceable to the effects of landfill leachate, were of negligible importance.

f. Any potential increases in the concentrations of parameters across landfill E were minor and of negligible importance.

g. In total, the landfills are having minimal impact on the streams flowing through Fort Monmouth.

h. Husky Brook, at the point where it flows onto Fort Monmouth, had concentrations of cadmium, zinc, and tetrachloroethylene which were higher than those at any other sampling location. All other parameters were detected at concentrations similar to those observed at the other SP's.

7. RECOMMENDATIONS.

a. Present the analytical results and conclusions of this study to the NJDEP in compliance with the NJPDES regulations.

b. Perform resampling at Landfill A to determine if the mercury results at this location were correct (This recommendation is based on good engineering practice.)

8. TECHNICAL ASSISTANCE. Requests for services should be directed through appropriate command channels of the requesting activity to the Commander, US Army Environmental Hygiene Agency, ATTN: HSHB-EW-M, Aberdeen Proving Ground, MD 21010-5422, with an information copy furnished the Commander, US Army Health Services Command, ATTN: HSCL-P, Fort Sam Houston, TX 78234-6000.

Michael E. Resch
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Environmental Engineer
Water Quality Engineering Division

Wayne A Fox
WAYNE A. FOX
Geologist
Waste Disposal Engineering Division

APPROVED:

for Stephen L. Kistner
JAMES H. STRATTA
LTC, MS
Chief, Water Quality Engineering Division

APPENDIX A

REFERENCES

1. State of New Jersey Department of Environmental Protection, Regulations concerning the New Jersey Pollutant Discharge Elimination System, N.J.A.C. 7:14A-1, et seq., March 1981.

2. Letter, this Agency, HSHB-EW-M, 2 July 1984, subject: Preliminary Report, Water Quality Engineering Study No. 32-24-0475-84, Stream Sampling for Landfill Discharge Determination, Fort Monmouth, New Jersey, 29 May - 7 June 1984.

3. TB MED 576, 15 March 1982, Sanitary Control and Surveillance of Water Supplies at Fixed Installations.

4. "Ground-water Resources of Monmouth County, New Jersey," Special Report No. 23, 1968, State of New Jersey Department of Conservation and Economic Development, Division of Water Policy and Supply.

5. "Installation Assessment of Fort Monmouth," Report No. 171, May 1980, US Army Toxic and Hazardous Materials Agency.

6. "Phase 1 Engineering Study and Compliance Plan, Fort Monmouth Solid Waste Landfill," 23 March 1981, William F. Cosulich Associates, P.C., Environmental Engineers.

APPENDIX B

PERSONNEL CONTACTED

1. US Government, Fort Monmouth, AV 992-1475
   Mr. Dinkerri Desai, Environmental Engineer

2. Preventive Medicine Service, Fort Monmouth, AV 992-2667
   a. Mr. Len Racioppi, Industrial Hygiene Program Manager
   b. 1LT Mike McDevitt, Environmental Science Officer

3. RCA Inc., Contractors, Fort Monmouth, (201) 532-4352
   Mr. Jeff Holtaway, Environmental Specialist

4. New Jersey Department of Environmental Protection, Division of Water Resources, (609) 292-0424
   a. Mr. Dave Kaplan
   b. Mr. Bill Brown

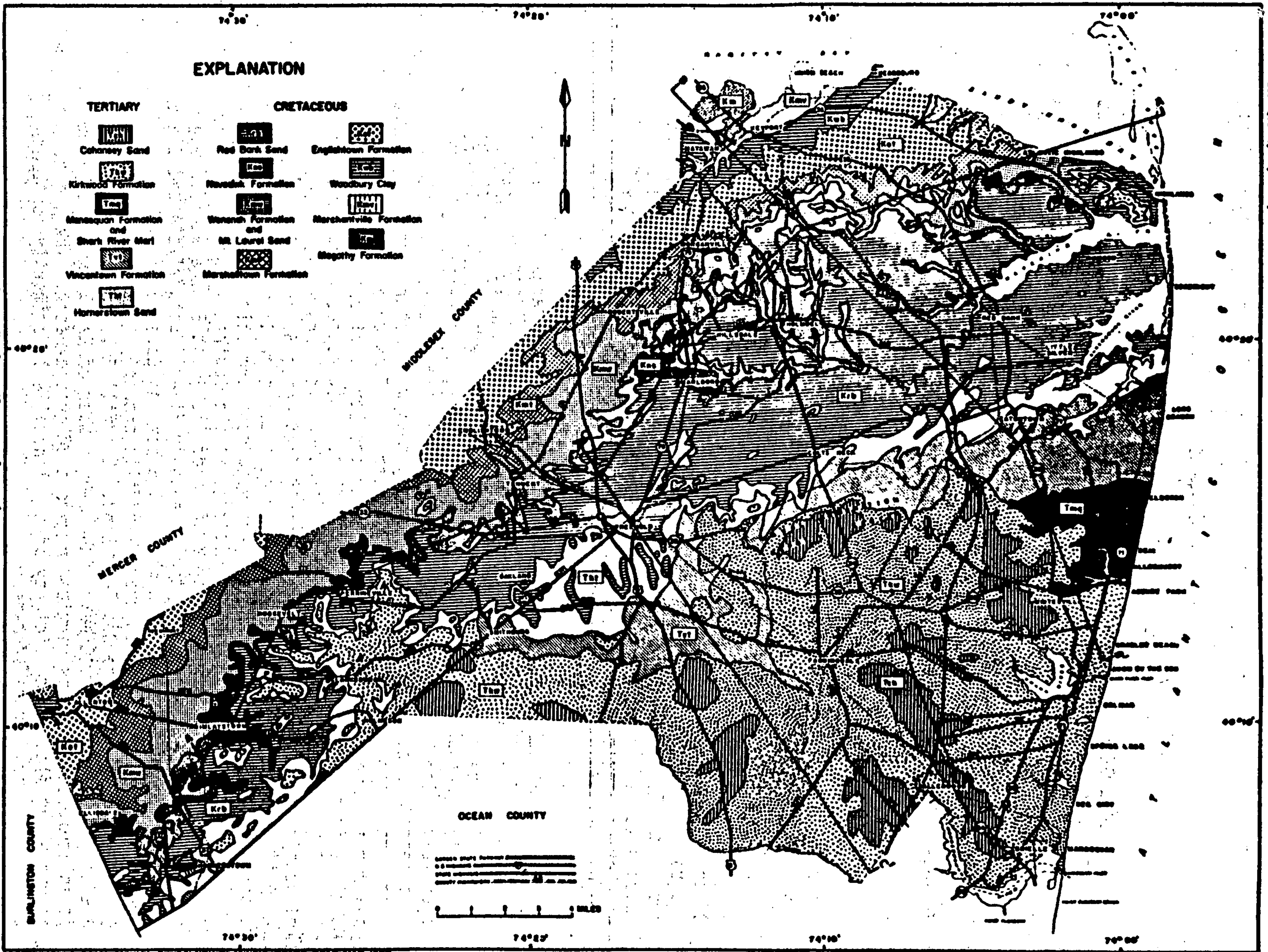
APPENDIX C

GEOHYDROLOGIC CONSIDERATIONS

1. REGIONAL GEOHYDROLOGY. Fort Monmouth is located on late Cretaceous and Tertiary Age marine and continental sediments of the Coastal Plain (reference 4, Appendix A). These sediments are composed of sand, silt, and clay with minor amounts of gravel. The Geologic Map (Figure C-1) shows the eroded edges of the formations in bands trending northeast-southwest. The formations dip from 10 to 62 feet per mile to the southeast, and total thickness increases from 500 feet in northwestern Monmouth County to 1200 feet in the southeastern part of the county (Figure C-2). The following Table provides stratigraphic and lithologic information for the mapped geologic units. The major aquifers in Monmouth County are the Raritan, Magothy, and Englishtown Formations, with 76 percent of the ground-water supplies being pumped from these formations. Monmouth County aquifers are recharged primarily from precipitation in the outcrop area. Ground-water discharge from these aquifers occurs along streams that cross the outcrop areas, except where ground-water pumpage is high.

2. LOCAL GEOHYDROLOGY. Fort Monmouth is underlain by the Tertiary Hornerstown Sand and the Cretaceous Red Bank Sand as shown on Figure C-3. Of the five former landfills at Fort Monmouth, as shown in the figure in the basic report, Landfills B and D are underlain by the Hornerstown Sand and Landfills A and E are underlain by the Red Bank Sand. Landfill C appears to be underlain by both units with the Red Bank Sand in the northern part close to Lafetra Brook and the Hornerstown Sand in the southern part of the landfill.

a. <u>Red Bank Sand Geohydrology</u>. The Red Bank Sand ranges in thickness from 30 to 140 feet and dips to the southeast at 35 feet per mile and strikes N 45° E. It overlies the Navesink Formation and is unconformably overlain by the Hornerstown Sand. Erosion of the Red Bank Sand prior to deposition of the Hornerstown Sand causes progressive thinning to the southeast. The Red Bank Sand contains two distinct members. The upper sand member is composed of slightly clayey medium- to coarse-grained quartz sand with minor amounts of mica and glauconite. This upper unit reaches a maximum thickness of 70 feet but thins to the southeast and is absent 4 to 6 miles from the outcrop. The lower member, which ranges in thickness from 20 to 70 feet, consists of medium- to fine-grained, very micaceous, clayey, glauconite sand. Apparently one borehole (reference 6, Appendix A) at Landfill E encountered the lower member at a depth of 31 feet. Only the upper member is considered an aquifer, with many domestic wells suppling 2 to 25 gallons per minute (gpm). Recharge to the aquifer is primarily from precipitation although, in the area of Landfills A and E, the aquifer may be affected by salt water from the Shrewsbury River. Landfills A and C are located in former marsh areas along Mill Brook and Lafetra Brook, respectively. The wastes in these landfills probably intersect the shallow ground-water table of the Red Bank Sand. Landfill E is located on a higher elevation above Parker's Creek. The lower member of Red Bank Sand, which is an aquiclude, impedes vertical movement of ground-water. Therefore, ground-water flow in the vicinity of the landfills is primarily horizontal to the adjacent surface streams.



BASE ADAPTED FROM MONMOUTH COUNTY PLANNING BOARD ROAD MAP, 1969

Figure 2.—Generalized pre-Quaternary geologic map of Monmouth County, New Jersey.

GEOLOGY ADAPTED FROM GEOLOGIC MAP OF NEW JERSEY, 1950 (REVISED)

FIGURE C-1. Geologic Map of Monmouth County, New Jersey (Source: reference 4, Appendix A).